

WHAT IS CLAIMED IS:

1. A method of fabricating photonic crystals of porous Si, comprising:
 - 5 providing a silicon substrate;
 - etching the silicon substrate to obtain a first patterned layer;
 - treating the first dielectric mirror to impart a first surface affinity to the first patterned layer;
 - 10 etching a second patterned layer immediately beneath the first patterned layer to a second patterned layer, wherein the first and second patterned layers are patterned to produce a characteristic reflection and predetermined wavelengths;
 - releasing the first and second patterned layers as a freestanding film;
 - 15 treating the second patterned layer to impart a second surface affinity to the second patterned layer; and
 - fracturing the free standing film into micron-sized particles.
2. The method of claim 1 wherein the silicon substrate comprises a single crystal silicon substrate.
3. The method of claim 1 wherein the first patterned layer is treated to impart a hydrophobic character.
4. The method of claim 1 wherein the second dielectric mirror is treated to impart a hydrophilic character.
- 25 5. The method of claim 1 further comprising hydrosilylating the first patterned layer to impart a hydrophobic character.

6. The method of claim 1 further comprising oxidizing the second patterned layer to impart a hydrophilic character.

5 7. The method of claim 1 wherein said etching comprises etching the silicon substrate with a time-varying electrical current to obtain the first patterned layer.

10 8. The method of claim 7 wherein said etching comprises etching the silicon substrate with a time-varying electrical current to obtain the second patterned layer.

15 9. The method of claim 1 wherein said releasing comprises applying a current pulse to release the first and second patterned layers as a freestanding film.

10. The method of claim 1 wherein said fracturing comprises ultrasonication of the freestanding film to fracture the freestanding film.

20 11. The method of claim 1 wherein said etching comprises etching the first patterned layer to have a first periodicity and the second patterned layer to have a second periodicity that is different from the first periodicity.

25 12. The method of claim 11 wherein said etching comprises etching first and second rugate filters on the silicon substrate.

13. Photonic crystal particles (10) of porous silicon that spontaneously assemble and orient to sense a local environment comprising:
30 a first patterned layer (12) having hydrophobic properties; and
a second patterned layer (14) disposed oppositely said first patterned layer, said second patterned layer having hydrophilic properties.

14. The particles of claim 13 wherein said first and second patterned layers comprise first and second rugate filters, respectively.

5 15. The particles of claim 13 wherein said first patterned layer has a first periodicity and said second patterned layer has a second periodicity that is different from said first periodicity.

10 16. A sensing system of photonic crystal particles (10) of porous silicon that spontaneously assemble and orient to sense a local environment comprising:

15 an aqueous environment suspected of including a target analyte;
a plurality of fractured silicon particles (10) having a first surface (12) that will self-align with the target analyte and a second surface (14) that will self-align with the aqueous environment.

17. The sensing system of claim 16 wherein said first surface includes a first rugate filter and said second surface includes a second rugate filter.

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18. The sensing system of claim 16 wherein said first surface is hydrophobic and said second surface is hydrophilic.

25 19. The sensing system of claim 16 wherein said aqueous environment is water.

20. The sensing system of claim 16 where the target analyte is hydrophobic.

30 21. A method of sensing a target analyte in solution comprising:

etching at least first and second rugate filters (12, 14) on a silicon substrate, with the first and second rugate filters being disposed one on top of the other;

5 varying surface affinities of the first and second rugate filters such that one of the first and second rugate filters exhibits hydrophilicity and the other exhibits hydrophobicity;

removing the silicon substrate;

fracturing a film comprising the first and second rugate filters to obtain particles having a hydrophobic side and a hydrophilic side;

10 immersing the particles in an aqueous environment suspected of containing the target analyte; and

observing the optical characteristics of the particles.

22. The method of claim 21 wherein said varying comprises
15 attaching dodecene to the first rugate filter to obtain the hydrophobic side and attaching an oxide species to obtain the hydrophilic side.

23. The method of claim 21 wherein said observing comprises observing changes in optical reflectivity properties of the particles.